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ABSTRACT

Research studies in science education have revealed that wait-time, the duration of teacher and student pauses in questioning dialogue, is an important variable in teaching. In this study, discussion materials were gathered, from 4 groups of 10 teachers, each week for a semester. The groups were defined as: (1) comparison group; (2) instruction in effective questioning group; (3) wait-time feedback group; and (4) instruction and wait-time feedback group. Discriminant function analysis and analyses of variance revealed that the wait-time feedback groups experienced greatest increases in wait-time and exhibited higher cognitive levels of interaction in classroom discussions. Longer student answers and more student talk were also found in the wait-time feedback groups. Re-analysis of the data separated the feedback groups into three categories: (1) those who maintained pauses of three seconds or more in several discussion sessions; (2) those who reached the three second criterion at least once in a discussion; and (3) those who were unable or unwilling to pause to the criterion. Significant differences favoring the effective wait-time group were found in the following areas: fewer memory-level, rhetorical, management, and leading questions; smaller percentage of teacher talk in discussions; and longer student answers. Eleven tables are included. (Author/JMK)

AN ANALYSIS OF CLASSROOM DISCUSSION BASED ON TEACHER SUCCESS IN OBSERVING WAIT TIME

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An Analysis of Classroom Discussion Based on Teacher Success in Observing Wait Time.

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Abstract

Research studies in science education have revealed that wait time, the duration of teacher and student pauses in questioning dialogue, is an important variable in teaching. In this study, discussion materials were gathered from four groups of ten teachers each week for a semester. The groups were defined as follows: a comparison group, an instruction in effective questioning group, a wait time feedback group, and an instruction and wait time feedback group. Discriminant function analysis and analyses of variance revealed that the wait time feedback groups experienced greatest increases in wait time and exhibited higher cognitive levels of interaction in classroom discussions. In addition longer student answers and more student talk were found in the wait time feedback groups. It was noted in the original analysis that teachers had great difficulty maintaining wait times of three seconds even with immediate feedback. It was also noted that without immediate feedback teachers were totally unsuccessful in achieving and/or maintaining three second pauses after questions and responses. A reanalysis of the data was conducted which separated the feedback groups into three categories: those who were successful in maintaining pauses of three seconds or more in several discussion sessions, those who were successful in reaching the three second criterion at least once in a discussion, and those who were unable or unwilling to pause to the criterion. The reanalysis revealed that the group that was most successful in maintaining pauses in questioning dialogue was different from the other groups on several important dimensions of classroom behavior. Significant differences favoring the effective (successful) wait time group were found in the following areas: fewer memory level questions, fewer rhetorical questions, smaller percentage of teacher talk in discussions, fewer management questions, fewer leading questions, and longer student answers. It was also expected that the successful wait time group would exhibit more questions of high cognitive level than the other groups, but that hypothesis was not supported. Implications of these findings for science education and for pre-service and in-service professional education are considered.

An Analysis of Classroom Discussion Based on Teacher Success in Observing Wait Time.

The concept of wait time in classroom dialogue was developed by Rowe nearly a decade ago (Rowe 1973, 1974). She identified two pauses in the dialogue between teachers and students that have been proven to be important variables in the determination of the cognitive level and affective climate of classrooms. A project designed to determine the effects of systematically increasing the pauses of teachers and students was recently conducted by Swift and Gooding (1983). In that study 40 teachers made tape recordings of a discussion in one of their classes each week for 15 weeks. The 40 teachers were divided into four groups for purposes of the project. One group received instruction in wait time using a newly developed electronic feedback device that monitors the duration of teacher and student pauses; a second group received instruction in general questioning skills; a third group received both types of instruction; and a comparison group received no instruction of either type.

Analysis of the discussion tapes revealed that wait time feedback devices facilitated the production of pauses that were significantly superior to baseline performance and to performance levels achieved by the groups that did not use the wait time devices. While significant differences favoring the wait time groups were found to occur, it was noted that many teachers and students, even in the wait time groups, had great difficulty reaching and maintaining pauses at the three second criterion which had been established. Due to that outcome, it was determined that a reanalysis of the data should be undertaken in

order to assess more directly the impact of pausing to the three second level.

Problem

The discriminant function analysis and analyses of variance performed originally revealed that the wait time feedback groups experienced greater increases in pause times. The presence of written instruction on pauses seemed to make little difference, and the comparison group likewise experienced little change. As noted above, though the groups with feedback devices were significantly different from the non-feedback group performance levels, it was deemed important to investigate whether any differences would be found among those teachers who had wait time feedback provided.

Method

The reanalysis plan called for the subdividing of the wait time feedback groups. Twenty of the 40 teachers were originally assigned to the feedback conditions. The reanalysis design separated the feedback teachers into three categories. These were delineated as criterion, partial criterion, and non-criterion achievers. The criterion group was defined to include only those teachers who increased their wait times beyond their baseline behavior, and who on more than one occasion exhibited pauses at or beyond a three second mean wait time. The partial criterion was defined as those who increased their wait times beyond baseline performance, but who reached a 3 second mean only once or not at all. The non-criterion group was defined as including those teachers who did not make significant changes in

wait times, or who instructed their students in the tape recordings to ignore the pause timer, or who made negative comments concerning pausing and/or the pause timer.

Using the definitions given above, the criterion group was found to contain five teachers, while the partial criterion group was made up of eight, and the non-criterion group was comprised of five teachers.

Analysis of the Data

The 40 teachers were grouped as follows: Group 1 (comparison), Group 2 (written instructions), Group 3 (feedback, non-criterion), Group 4 (feedback, partial criterion), and Group 5 (feedback, criterion).

Evaluation of the effects of the five conditions was performed using an ANOVA for each variable of interest. The ANOVA procedure was followed by a multiple range test, LSD procedure, which provided multiple comparisons between all pairs of groups (Hull & Nie, 1981). The 21 variables tested were those which were relevant to the content level of discussion, questioning complexity, and student-teacher discussion input and output. These are listed in the following section.

Results

As expected there were significant differences between groups for wait time 1 ($F < .0001$) and for wait time 2 ($F < .0001$). Mean wait time 1 and 2 assessments using LSD procedure revealed that group 5 was significantly different from all other pairs

Insert Tables 1 and 2

of groups on both variables as seen in Tables 1 and 2.

Therefore, the definitions did provide a valid basis for separation of the wait time feedback teachers into three subgroups. The wait time 1 mean for the criterion group (group 5) was 3.78 seconds and the wait time 2 was 8.04 seconds.

Analyses of variance were performed for 21 relevant variables: memory level questions, classification and reformulation level questions, application and judgment level questions, divergent questions, evaluative questions, rhetorical questions, management questions, leading questions, non-response questions, chain questions, number of student answers, length and number of student questions, non-response questions, mean length of answers, student questions and student discussions, and percentage of teacher talk. Significant between group F ratios were obtained for eight variables in the reanalysis set, as seen in summary tables 3 through 11. The results revealed that the

Insert Tables 3 - 11 here

group that was most successful in maintaining pauses at or near the three second criterion was different from the other groups on several important dimensions of classroom discussion. Significant differences favoring the successful criterion group (group 5) were found in the following areas: fewer memory level questions were posed by the teacher, fewer rhetorical and leading questions were noted, percentage of teacher talk in discussions was lower, and fewer management type questions were asked by the teacher. The length of student responses was significantly increased, and the students gave more answers per question posed. Only one of the significant differences favored the non-criterion

group (group 3), albeit only slightly and not significantly different from the criterion group. This was a highly important variable and produced a result which the authors find difficult to explain. The non-criterion group (group 3) received higher scores on evaluative level discussion that did the group having the wait times at or near the criterion of three seconds.

Discussion

Since the time of the early classroom interaction studies conducted by Flanders (1970), researchers have been cognizant of the fact that teacher talk dominates classroom discussion. Accordingly, it was a pleasure to find that increasing the pause times to the length suggested by Rowe (1973, 1974) was successful in significantly reducing the percentage of teacher talk in the classroom. Related to this are the additional significant results finding fewer numbers of rhetorical questions, leading questions and management questions in the longer wait time group. These results enable us to suggest the hypothesis that these classrooms are more likely to be places where there is less emphasis on teacher dominated discussion. That the students in the criterion group produced longer answers and more answers shows the power of increasing wait time 2. As the authors have noted elsewhere (Swift and Gooding, 1983), the teacher has more control over wait time 2 than over wait time 1, yet often experiences greater difficulty in observing that pause. The evidence here is clear. When teachers do take the time to pause when students are speaking, the length of answers and the number of responses both are increased. It is hypothesized that this

increase in student response will enhance motivation, since the students are able to contribute more to the discussion at hand.

In summary, therefore, it is important to work toward extending wait times to the three second criterion proposed by Rowe in her earlier studies. It appears to have an effect not only on the cognitive variables in the classroom, but also has implications for the affective climate as well. Furthermore, while the three second criterion generally produces more of the desirable outcomes indicated, any significant increase in wait time can contribute to more effective classroom discussions. Pre-service and in-service educators alike can benefit from increasing these pauses and moderating the pace of their classroom interaction. A recent project reported by Gooding, Swift, and Swift (1993) provided evidence to support the hypothesis that increasing wait time in the classrooms of experienced teachers through supportive feedback and provision of wait time monitoring devices created even more powerful changes than expected.

Research has amply demonstrated the importance of wait time. The task now before us is primarily developmental. Faculty development and professional education programs must address the creation of strategies for effectively enabling teachers to learn to use pauses and to create discussion patterns which will elevate the cognitive level and affective climate of the classroom. Developmental projects which will provide a means to achieve these goals are essential to our educational progress.

Table 1 - Wait time 1 (Seconds)

Group	Count	Mean	Standard Deviation
1 (comparison)	49	1.1884	0.6704
2 (guides)	49	1.3482	0.5307
3 (non-criterion)	25	1.4982	0.7923
4 (part-criterion)	48	1.7680	1.3211
5 (criterion)	25	3.7852	2.0221

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	128.4952	32.1238	26.639	0.0000
Within groups	191	230.3219	1.2059		
Total	195	358.8170			

Table 2 - Wait Time 2 (Seconds)

Group	Count	Mean	Standard Deviation
1 (comparison)	49	0.5354	0.2138
2 (guides)	49	0.6846	0.2792
3 (non-criterion)	25	0.7361	0.2871
4 (part-criterion)	48	0.7680	1.3211
5 (criterion)	25	2.0401	1.6793

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	41.9947	10.4987	20.798	0.000
Within groups	191	96.4172	0.5048		
Total	195	138.41119			

Table 3 – Memory Level Questions

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	2188.9009	547.2252	4.646	0.0013
Within groups	191	22495.5749	117.7779		
Total	195	24684.4758			

Multiple Range Test

Mean	Group	Group 5 1 4 2 3
8.2482	Grp 5	
12.9118	Grp 1	
13.6815	Grp 4	*
17.1347	Grp 2	*
19.8533	Grp 3	* * *

(*) Denotes pairs of groups significantly different at the .05 level

Table 4 – Rhetorical Questions

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	105.3180	26.3295	4.101	0.0033
Within groups	191	1226.3941	6.4209		
Total	195	1331.7129			

Multiple Range Test

Mean	Group	Group 5 4 1 2 3
0.8903	Grp 5	
1.3310	Grp 4	
2.1272	Grp 1	*
2.1935	Grp 2	*
3.4253	Grp 3	* * *

(*) Denotes pairs of groups significantly different at the .05 level

Table 5 - Percent of Teacher Talk

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	1700.6823	425.1706	5.591	0.0003
Within groups	191	14524.0621	76.0422		
Total	195	16224.7443			

Multiple Range Test

		Group				
Mean	Group	3	5	4	2	1
76.6244	Grp 3					
78.9300	Grp 5					
79.0702	Grp 4					
81.9461	Grp 2		*			
85.2674	Grp 1		*	*	*	

(*) Denotes pairs of groups significantly different at the .05 level

Table 6 - Management Questions

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	610.1529	152.5382	4.707	0.0012
Within groups	191	6189.5478	32.4060		
Total	195	6799.7007			

Multiple Range Test

		Group				
Mean	Group	5	2	1	3	4
2.9279	Grp 5					
3.1152	Grp 2					
5.1179	Grp 1					
6.1953	Grp 3		*	*		
7.4678	Grp 4		*	*	*	

(*) Denotes pairs of groups significantly different at the .05 level

Table 7 - Leading Questions

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	96.8578	24.2144	3.377	0.0107
Within groups	191	1369.5261	7.1703		
Total	195	1466.3839			

Multiple Range Test

		Group				
Mean	Group	5	4	1	2	3
0.9715	Grp 5					
1.6699	Grp 4					
1.6864	Grp 1					
2.6400	Grp 2				*	
3.2727	Grp 3				*	*

(*) Denotes pairs of groups significantly different at the .05 level

Table 8 - Length of Answers

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	49195.7472	12298.9368	2.726	0.0307
Within groups	191	861659.8513	4511.3081		
Total	195	910855.5985			

Multiple Range Test

		Group				
Mean	Group	1	2	4	3	5
68.4485	Grp 1					
96.9550	Grp 2		*			
103.9467	Grp 4		*			
105.9365	Grp 3		*			
112.4970	Grp 5		*			

(*) Denotes pairs of groups significantly different at the .05 level

Table 9 - Mean Length of Answers

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	177.5656	44.3941	6.210	0.0001
Within groups	191	1365.4077	7.1487		
Total	195	1542.9733			

Multiple Range Test

		Group				
Mean	Group	3	1	2	4	5
3.4866	Grp 3					
3.5557	Grp 1					
3.8624	Grp 2					
4.9483	Grp 4	*	*	*		
6.3494	Grp 5	*	*	*	*	

(*) Denotes pairs of groups significantly different at the .05 level

Table 10 - Number of Answers

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	3425.5018	856.3755	6.045	0.0001
Within groups	191	27059.6391	141.6735		
Total	195	30845.1410			

Multiple Range Test

		Group				
Mean	Group	5	1	4	2	3
17.2780	Grp 5					
19.0201	Grp 1					
24.3648	Grp 4					
26.4627	Grp 2	*				
29.8644	Grp 3	*	*			

(*) Denotes pairs of groups significantly different at the .05 level

Table 11 – Evaluative Questions

Analysis of Variance

Source	df	SS	MS	F Ratio	F Prob.
Between groups	4	60.5116	15.12798	2.570	0.0394
Within groups	191	1124.3113	5.8864		
Total	195	1184.8228			

Multiple Range Test

Mean	Group	Group: 2 1 4 5 3
0.2775	Grp 2	
0.3465	Grp 1	
0.4569	Grp 4	
0.9792	Grp 5	
1.9872	Grp 3	* * *

(*) Denotes pairs of groups significantly different at the .05 level

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